MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 2, 2018/2019**

## ECP3126- KNOWLEDGE-BASED SYSTEMS

**(RE & TE)**

5 MARCH 2019
2.30 PM – 4.30 PM
(2 Hours)

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**INSTRUCTION TO STUDENTS**

1. This question paper consists of 5 pages including cover page with 5 questions only.

2. Attempt **ALL** the **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

## Question 1

(a) What is an expert system? Explain the purpose of knowledge base and inference engine components of knowledge-based systems. Mention any two advantages and disadvantages of knowledge-based systems.

[1+3+4 marks]

(b) Prototype construction is an important stage in expert system development life cycle. Write the specific important purpose of prototype construction and list the various steps involved in the prototype development process.

[6 marks]

(c) Represent the information "All MMU students are smart" using predicate logic with respect to the following different domains.

(i) MMU students.

(ii) All university students.

[2 marks]

(d) Analyze the differences between heuristic search algorithms and blind search algorithms. Write an example for each category of searching algorithms.

[4 marks]

## Question 2

(a) A fuzzy rule is a simple IF-THEN rule with a condition and a conclusion.
Why there is no ELSE? Use the following to form any four valid fuzzy rules for a simple temperature regulator that uses a fan.
Input linguistic variable: Temperature (hot, normal, cold and very cold).
Output Action: stop fan, turn down fan, maintain level, and speed up fan.

[6 marks]

(b) Design a fuzzy controller (specifying the fuzzy input sets, output sets along with their membership functions and rules) to control the supply of power to the compressor of a freezer whose operational conditions are given below.

- The ideal temperature of the freezer is 0 degrees centigrade, while the variation in internal temperature is not expected to be more than +5 or -5 degrees.
- The maximum rate of change of temperature is expected to be within +2 or -2 degrees per hour.
- The compressor is expected to be powered in the range of 0 to 2 kW.

[10 marks]

**Continued...**

(c) Analyze the differences between the following plots shown in Figure Q2d(i) and Figure Q2d(ii).

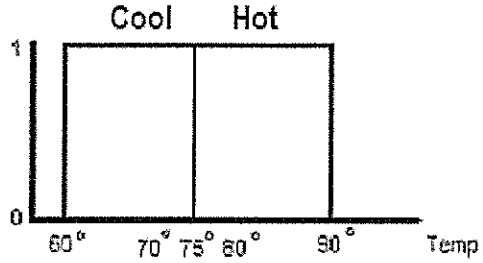


Figure Q2d(i)

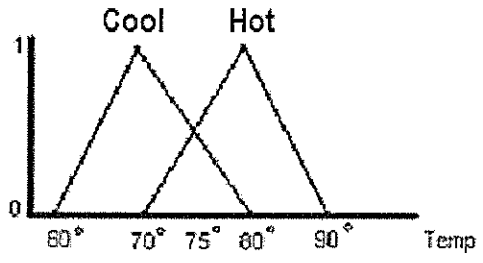


Figure Q2d(ii)

[4 marks]

## Question 3

(a) Define Artificial Neural Network (ANN)? What feature of the human brain is very hard to create in computer? Explain your answer with suitable examples.

[1+1+3 marks]

(b) What is the meaning of training in Artificial Neural Network (ANN)? Summarize the steps involved in the general learning algorithm of supervised training. What type of problems can be generally solved by supervised learning?

[1+4+1 marks]

(c) Design a McCulloch-Pitts neurons network model that can perform the OR logic function. Realize your design by using the truth table of OR logic function.

[5 marks]

(d) Explain the main limitation of a single-layer perceptron network with an appropriate example.

[4 marks]

**Continued...**

## Question 4

(a) Consider the multiplayer perceptron network shown in Figure Q4a that solves the 2-bit XOR problem.

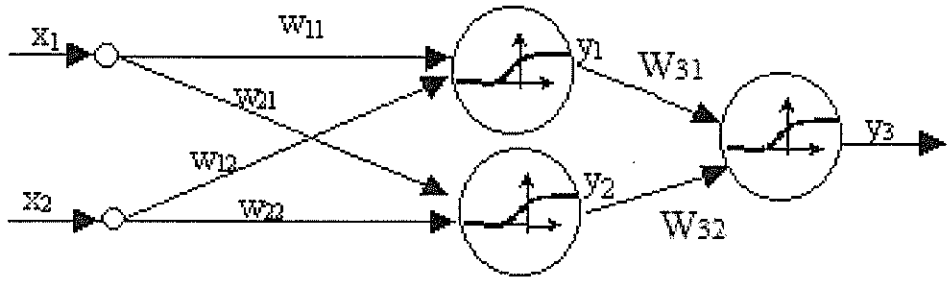


Figure Q4a

The initial weights are set randomly as follows:

$$w_{11} = 0.5, w_{12} = 0.8, w_{21} = 0.6, w_{22} = 0.3, w_{31} = 0.3, w_{32} = 0.7$$

Perform a single training step using Error Back-propagation training algorithm to find the updated weights for $W_{31}$ and $W_{32}$ for input $x_1$ and $x_2$ equal to 1. The learning rate is 0.6.

Sigmoid activation function $\varphi(v) = \dfrac{1}{1+e^{-\alpha v}}$ is used with $\alpha$ equals to 1.

[12 marks]

(b) Train the ANN shown in Figure Q4b using winner takes all unsupervised learning algorithm for the following training data. Use 0.5 as learning rate.

| | P1 | P2 | P3 | P4 |
|---|---|---|---|---|
| X | 0.2 | 0.8 | 0.3 | 0.7 |
| Y | 0.2 | 0.8 | 0.3 | 0.7 |

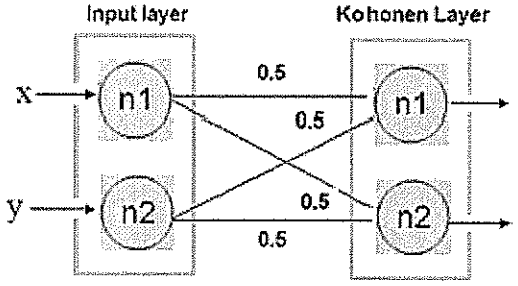


Figure Q4b

[8 marks]

**Continued...**

## Question 5

(a) Using bipolar encoding determine the BAM weight matrix for the following exemplars.

| X | Y |
|---|---|
| [1 1 1 ] | [1 1 ] |
| [0 0 0 ] | [1 0 ] |
| [1 0 1 ] | [0 1 ] |

Show how recall is done for the noisy input vector X = [1 1 0]

[8 marks]

(b) Explain why networks like BPN are not good models to store information in an elastic way. How can ART networks store information in an elastic way?

[4 marks]

(c) (i). What is the purpose of Gain 1 and Gain 2 modules of ART network?

[2 marks]

(ii). Name the rule implemented in the following equation.

$$C_i = \begin{cases} 1 & \text{if } P_i + G_1 + X_i \geq 2 \\ 0 & \text{if } P_i + G_1 + X_i < 2 \end{cases}$$

[1 mark]

(iii). Which phase of ART network is using this rule?

[1 mark]

(iv). How can ART learn new things without necessarily forgetting things learned in the past?

[2 marks]

(v). Analyze the effect of setting the vigilance parameter very high value or very low value.

[2 marks]

**End of paper**